REMARKS

In the Office Action, dated November 15, 2007 the Examiner states that Claims 8-17 are pending, and Claims 8-17 are rejected. By the present Amendment, Applicant amends the claims.

In the Office Action, Claims 8-11, 16 and 17 are rejected under 35 U.S.C. §103(a) being unpatentable over JP 3-41078 in view of Bush (US 3,893,660). Claims 12-15 are rejected under 35 U.S.C. §103(a) as being unpatentable over Takizawa (US 6,834,861) in view of JP 3-41078. Claims 16 and 17 are rejected under 35 U.S.C. §103(a) as being unpatentable over Takizawa in view of JP 3-41078 and Bush. Claims 8-11 are rejected under 35 U.S.C. §103(a) as being unpatentable over Masuyama (US 6,860,485) in view of Bush. Claims 12-15 are rejected under 35 U.S.C. §103(a) as being obvious over Takizawa in view of Masuyama. Claims 16 and 17 are rejected under 35 U.S.C. §103(a) as being unpatentable over Takizawa in view of Masuyama and Bush. The Applicant considers that the amendments to the claims overcome these rejections.

Claim 8 has been amended to incorporate the limitation of former Claims 9-11 and the limitation that "the width of the oil ring in the axial direction is in a range of 0.3 mm to 3.0 mm". In accordance with this, former Claims 9-11 are cancelled.

Former Claims 10 and 11, include the feature "a ratio of the thickness and a width of the cross sectional shape of the anomaly wire, which forms the coil expander is in a range of 1:1 to 1:4". However, in amended Claim 8, the ratio is "<u>1:1.5 to 1:3.5</u>", on the basis of the description of the present specification as provided in the Examples.

Further, former independent Claim 12, and former dependent Claims 13-17 depending on former Claim 12, are cancelled.

A feature of amended Claim 8 is that "a ratio of a thickness and a width of the cross sectional shape of the anomaly wire, which forms the coil expander, is in a range of 1:1.5 to 1:3.5". By making the ratio of a thickness and a width in the above range, a variable tension margin of 40% or more can be obtained.

The effect, of making the dimensional ratio a ratio of a thickness and a width of the rectangular cross sectional shape within 1:1.5 to 1:3.5, is provided in the description in the Examples (particularly Table 1) of the specification and Figure 9. In the Examples, tension variations of the coil expander before and after martensitic

transformation (variable tension margin) are obtained by using wire materials having various dimensional ratios. From Table 1 showing the results thereof and Figure 9 which is a graphed figure of table 1, it is clear that in the case of dimensional ratio of 1:1.5, the variable tension margin is 2-folded compared to the case of a dimensional ratio of 1:1.

As described-above, by making the ratio in a range of 1:1.5 to 1:3.5, a variable tension margin of 40% or more can be obtained. This means that if the tension is set to such a value that oil consumption can be satisfied at a high temperature (high rotation region), that is, after the martensitic transformation, the tension at the normal temperature can be set low by about 30% (1/1.4 = 0.714), and friction can be reduced. Therefore, the optimal tension can be obtained both at start up of an engine and at a high rotation, so that fuel economy can be enhanced.

As described in page 3, lines 8-23, the modulus of transverse elastically of the shape memory alloy is lower than commonly used steel. Therefore, when a wire material made of shape memory alloy is used for a coil expander, in order to obtain the same tension as that of commonly used steel wire, it is necessary to increase the thickness of the wire. Thus, there has been a problem that the coil expander made of shape memory alloy cannot be particularly used.

In the present invention, as described in amended Claim 8,

(i) even when the coil expander formed of the shape memory alloy that is "treated such that if a temperature of the coil expander itself is higher than a martensitic transformation temperature of the shape memory alloy, the coil expander extends in its longitudinal direction" is used,

(ii) by using anomaly wire having "rectangular cross sectional shape" wherein " a ratio of a thickness and a width of the cross sectional shape of the anomaly wire is in a range of 1:1.5 to 1:3.5",

(iii) sufficient tension can be obtained even when the coil expander is used in combination with an oil ring whose width in the axial direction is in a range 0.3 mm to 3.0 mm. Thus, the present invention makes it possible to use a coil expander formed of shape memory alloy in combination with a thinned oil ring.

In relation to the difference between the claimed invention and the cited references, both JP' 078 and Masuyama merely disclose the coil expander formed of shape memory alloy. In JP' 078 and Masuyama, there is no description about using

such a coil expander formed of shape memory alloy in combination with a thinned oil ring. Thus, it would appear that these cited references are not aware of the above-mentioned problem.

Moreover, Bush discloses to form the outer-ring-engaging surface of each coil of the spring into the same curvature as the inner surface of the piston ring, in order to reduce or eliminate wear between the piston ring and the helical spring. Thus, the problem to be solved and the effect of the invention of Bush are totally different from that of the present invention. In Figure 4 and 5, Bush discloses a cross sectional view of a wire which is approximate square with thickness: width = about 1:1. However, this shape derives from the intention of Bush's invention, that is, to form the outer ring-engaging surface of each coil of the spring into the same curvature as the inner surface of the piston ring. Therefore, there is no description about the relation between the cross-sectional shape of the wire and the tension. For the above-mentioned reasons, there is no motivation for those skilled in the art to employ the cross-sectional shape Bush discloses with the invention of JP' 078 or Masuyama, in order to obtain greater tension. Takizawa discloses an oil ring whose width in the axial direction is in a range of 1.2-2.0 mm, which is similar to that in the present invention. However, Takizawa's invention relates to nitrided surface layers formed on the oil ring. Since Takizawa does not use a shape memory alloy for the coil expander, Takizawa is not aware of the above-mentioned problem in using a shape memory alloy in combination with a thinned oil ring.

Further, the above-mentioned cited references do not disclose or suggest that "a ratio of a thickness and a width of the cross sectional shape of the anomaly wire, which forms the coil expander, is in a range of 1:1.5 to 1:3.5". Still more, they do not disclose or suggest that variation of tension before and after the martensitic transformation can be adjusted by adjusting the ratio of a thickness and a width of the cross sectional shape of the anomaly wire formed of shape memory alloy.

As described above, without the present invention, a coil expander formed of shape memory alloy, in which optimal tension can be expressed both start up of an engine and at high rotation, cannot be used in combination with a thinned oil ring. The present invention makes this possible by employing various feature disclosed in the cited references together with a feature that is not disclosed in the cited references.

Therefore, the present invention is not considered obvious from the cited references.

In light of the foregoing response, all the outstanding objections and rejections are considered overcome. Applicant respectfully submits that this application should now be in condition for allowance and respectfully requests favorable consideration.

Respectfully submitted,

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